From: Ward, Richard [RWard@kenyon.com]
Sent: Monday, November 19, 2007 4:40 PM
To: Darton,Terry
Subject: Mirant SOP Comments

Dear Mr. Darton,

Attached are my comments regarding the Mirant facility. Thank you for your hard work in coordinating this permitting issue.

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Comments on the Draft State Operating Permit for the Mirant Potomac River LLC's Potomac River Generating Station, submitted by Richard W. Ward, Esq.

Dear Mr. Darton and Members of the Virginia Air Pollution Control Board,

Thank you for your continued attention to the Mirant matter in Alexandria, VA. I believe that the Virginia Department of Environmental Quality ("VADEQ") has made an admirable attempt to improve the operation of the Mirant power plant, and that the proposed permit conditions would reduce pollutant levels significantly. Unfortunately, owing to aspects which have not yet been adequately considered by VADEQ, Mirant, and the City of Alexandria, it is likely that there is no practicable manner in which a coal-burning power plant can safely operate in its current location. In short, the Mirant plant is located in the vicinity of a large body of water and significant terrain features which are evidenced to cause complex local wind conditions, such as inversions, stagnations and fumigations. Under persistent inversion, stagnation and/or fumigation conditions, there would be no safe manner in which even a single coal-fired boiler can operate under the permit conditions proposed by VADEQ – let alone three. Correspondingly, it is my recommendation that the Virginia Air Pollution Control Board immediately require parametric monitoring which can detect inversion, stagnation, and fumigation events, so as to protect the health of residents of Alexandria, Virginia and its environs. Such monitoring should include, as a minimum, on-site monitoring of meteorological conditions and several permanent off-site emissions monitoring locations. In conjunction with such data gathering, increased attention to modeling stagnation, inversion and fumigation events using EPA recommended CALPUFF software is also recommended.

BACKGROUND

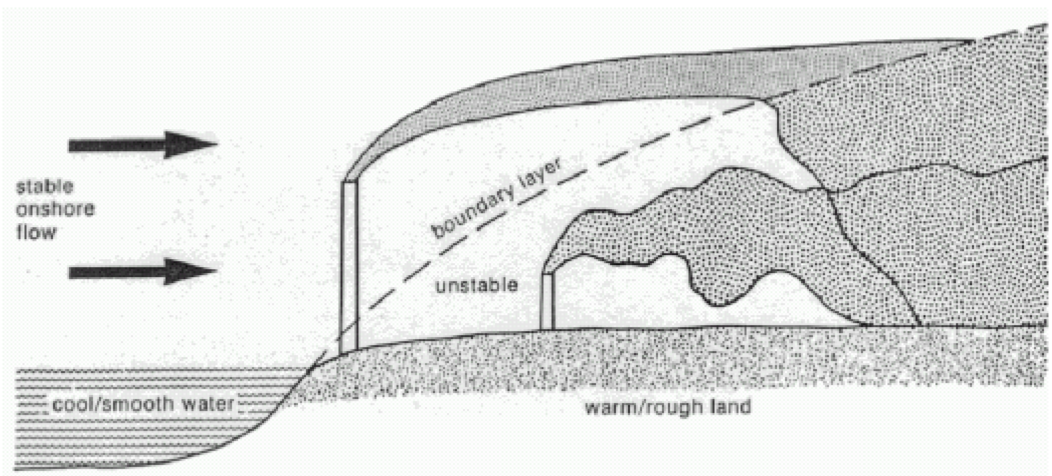
The EPA's Guideline of Air Quality Models ("Appendix W") addresses complex winds in Section 7.2.8. Appendix W recognizes that:

> In many parts of the United States, the ground is neither flat nor is the ground cover (or land use) uniform. These geographical variations can generate local winds and circulations, and modify the prevailing ambient winds and circulations. Geographic effects are most apparent when the ambient winds are light or calm. In general these geographically induced wind circulation effects are named after the source location of the winds, *e.g.*, lake and sea breezes, and mountain and valley winds. In very rugged hilly or mountainous terrain, along coastlines, or near large land use variations, the characterization of the winds is a balance of various forces, such that the assumptions of steady-state straight-line transport both in time and space are inappropriate. In the special cases described, the CALPUFF modeling system (described in Appendix A) may be applied on a case-by-case basis for air quality estimates in such complex non-steady-state meteorological conditions.

As further stated by Appendix W, examples of inhomogeneous winds include, but are not limited to, inversion breakup fumigation, shoreline fumigation, and stagnation.

Stagnation conditions are evidenced by periods of little to no wind, during which pollution can concentrate near a pollution source. Without wind, pollution disperses very slowly. It is noted that AERMOD is unable to adequately address stagnation conditions having a wind speed of about 2 knots and below, and the use of CALPUFF is recommended in Appendix W to model such instances.[1]
An inversion (or more accurately, a temperature inversion) is an increase in temperature with height above the ground. Inversions prevent the rise of heated emission plumes, which often causes plumes to mix, or even "dive" to the relatively cooler ground level air. Such inversions are often evidenced by fog (or smog) formation, such as the fog which not infrequently occurs in the Potomac River Valley. Extreme instances of inversion conditions are attributed as being primary drivers for the passage of Clean Air Acts in the United States and the United Kingdom.[2] According to Appendix W, there allegedly is no accurate way to model stagnation conditions.

Finally, shoreline fumigation conditions may cause pollution to be heavily concentrated over extended periods of time, as depicted in the figure below:



Such phenomena may be modeled by software such as SCREEN3 and DISPMOD, the latter of which was used as the basis of the figure above.[3] As can be seen in the figure, when a stack plume originally emitted into stable air contacts unstable air over warm or

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1 Owing to the use of National Airport wind speed data by the AERMOD dispersion models to date, stagnation conditions were not considered. National Airport reports wind speeds lower than two knots as a "calm," and "calm" conditions are typically disregarded by AERMOD modeling software, allegedly because unrealistically high concentrations are calculated by AERMOD during such conditions.

2 The Donora, PA fluoride fog of 1948,which killed dozens, and the Great Smog of 1952 in London, which killed thousands, have been attributed to inversion events. Clean Air Acts were passed soon afterwards. A more modern day incident is the 1984 Union Carbide disaster. During this incident, methyl isocyanate was vented at a level of 33 meters, and was subsequently trapped beneath a nocturnal inversion layer, killing thousands in the nearby city of Bhopal, India.

3 *See http://www.dar.csiro.au/pollution/localscale/sld009.htm* (Accessed November 19, 2007).

rough (*e.g.*, urban) land, it rapidly mixes to the land surface, causing a potentially significant, and extended, pollution event.

ANALYSIS

<u>Modeling efforts to date have failed to accurately consider inversion, stagnation, and fumigation conditions.</u>

To date, dispersion modeling efforts have concentrated on the effects of large land use variations, primarily the adjacent Marina Towers, on local winds. *See*, *e.g.*, DEQ Interoffice Memorandum from Mike Kiss to Tamera Thompson (April 19, 2007), pp. 5-6. Such studies have primarily used AERMOD modeling software, supplemented by wind tunnel studies funded by Mirant. While such studies possibly address transient issues associated with the impaction of plumes on the Marina Towers, they fail to adequately consider other possible causes for observed pollution events, especially those in areas not in the vicinity of the Marina Towers.

I have reviewed in detail the dispersion models submitted by the City of Alexandria, as well as the modeling protocol proposed by Mirant. Both assume that near-ground level wind speeds are the same as those measured at National Airport, and that higher level air is the same as that at Dulles Airport. While such assumptions may be adequate for plants with tall stacks constructed in accordance with Good Engineering Practice (GEP), it is well known that Mirant's stacks are too short, *i.e.*, the stack heights at Mirant are constrained by its proximity to flight paths of airplanes using National Airport. As a result, significant impacts on pollutant plumes can occur from local features, such as surrounding buildings, trees, hills, and boundary layers created by Mirant's proximity to wide portions of the Potomac River.[4] Furthermore, owing to differences in temperature between the land and the Potomac River, unusual temperature profiles may occur in the vicinity of a river valley, resulting in inversions and resultant fog/smog formation. Dulles Airport is not located in a river valley; thus, at least wind speeds and temperatures for the first few hundred feet above the level of the Potomac River Valley could be drastically different than that of Dulles Airport.

<u>Initial screening of stagnation, inversion, and fumigation conditions indicate that such may be the cause of NAAQS violations in the vicinity of the Mirant plant.</u>

Owing to the lack of reliable upper air speed and temperature data, I used the SCREEN3 model (the same program used by David Sullivan in his original Mirant analysis) to

[4] Furthermore, based on another contemporary study conducted by Aero Engineering, it is believed that at least the City of Alexandria's model failed to consider wind speeds from National Airport lower than about 3 miles per hour. It is also noted that National Airport's weather station reports wind speeds below 2 knots as "calms." Such can result in a dramatic underprediction of pollutant levels during stagnation conditions, as such calm periods cannot be modeled using AIRMOD (Appendix W suggests using CALPUFF for such modeling), and wind speed data is adjusted to account for allegedly "unrealistic" modeling results caused by low wind speeds.

screen for the possibility of NAAQS violations in the vicinity of the Mirant plant if confronted with near worst-case stagnation and/or fumigation conditions. For this screening study I used proposed permit limits for sulfur dioxide for Unit 1 as proposed in the permit under consideration.

To simulate inversion conditions, I assumed that stack gases would leave the stack at very low velocity, and negated buoyancy effects by setting stack gas temperature equal to that of ambient air. This addresses the realistic situation of temperature inversions, during which emitted plumes are often observed to dive to the ground. I also set ground-level wind speed to the model minimum, 1 m/s (or about 2 knots). Very significant violations of NAAQS were observed –even though only a single stack was modeled. Furthermore, such violations are consistent with empirical observations (i.e., testimony at Board hearings) of ground level smoke in the vicinity of the Mirant plant.

I also performed screening-type fumigation calculations using SCREEN3, and such calculations indicated that shoreline fumigation conditions could cause violations of NAAQS in areas over 1 km from the plant. Such could help to explain excessive soot found in homes in the southern section of Old Town Alexandria.

More modeling is required to conform with EPA guidelines

As an initial matter, it is noted that Appendix W was amended on October 19, 2007; thus, any previous models did not consider such guidance, including *inter alia*, new guidance pertaining to the proper selection of meteorological monitoring stations. Second, my preliminary screening analysis, as well as empirical evidence, indicates that the Marina Towers may not be the sole cause of NAAQS violations in Alexandria and its environs. Appendix W mandates that the possibility of inhomogeneous local winds be considered, and no effort, other than the Marina Towers analysis, appears to have been expended to this end. If through empirical observation it is determined that inhomogeneous local winds do indeed exist, the EPA-recommended CALPUFF modeling tool should be used.

There is a need for increased monitoring

Besides requesting comments on the proposed Mirant permit in general, the Board has specifically requested comments on the degree of continuous emissions monitoring needed. At this time, it is my opinion that instead of increasing the degree of continuous emissions monitoring on the Mirant site, it is more important to monitor, on a permanent basis, particulate matter and sulfur dioxide levels at multiple points generally south and west of the Mirant facility. Such points should be selected to optimize the detection of inversion, stagnation, and fumigation driven effects, as determined by increased modeling efforts as specified above. It is my understanding that a six week temporary study was conducted this summer; however, such a study would at least need to be repeated in the winter months, when inversion conditions are much more common.

CONCLUSION

As the dispersion modeling performed to date does not appear to accurately predict the empirical observations of the surrounding community, *i.e.*, smoke filled streets and soot build-up, further efforts are required before the proposed permit is approved. In the interim period, reduction of plant operations should be maintained, CALPUFF modeling should be performed, and more empirical data should be gathered. As a chemical engineer and a practicing patent attorney, it is relatively straightforward to find problems with the conducting of a scientific analysis. The more difficult part is finding the correct answer. If I can help in anyway, I can be reached via the contact information below.

Thank you for your time and consideration,

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